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UNITED STATES DEPARTMENT OF AGRICULTURE
Bureau of Agricultural Economics

In Cooperation With

WISCONSIN AGRICULTURAL EXPERIMENT STATION
and
MINNESOTA AGRICULTURAL EXPERIMENT STATION

Reserve

X HAY HARVESTING PRACTICES IN WISCONSIN AND MINNESOTA

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Milwaukee, Wisconsin
April 1946

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THE UNIVERSITY OF CHICAGO
DIVISION OF THE PHYSICAL SCIENCES
DEPARTMENT OF CHEMISTRY
IN COOPERATION WITH
NATIONAL BUREAU OF STANDARDS
WASHINGTON, D. C.

THE UNIVERSITY OF CHICAGO

DEPARTMENT OF CHEMISTRY

HAY HARVESTING PRACTICES IN WISCONSIN AND MINNESOTA 1/

By

Emil Rauchenstein, Agricultural Economist
Bureau of Agricultural EconomicsThe Problem

No one way of putting up hay is best for all farms. The choice of a method, or methods, for a farm is influenced by such factors as the quantity of hay to be harvested, the use to be made of the hay, the condition of the fields, the distance the hay is moved to storage, and the labor force, power and hay-harvesting equipment on the farm, or the capital available for buying new equipment.

Putting up enough forage crops for the livestock kept on representative farms in southeastern Wisconsin or southeastern Minnesota usually results in a high peak of work for several weeks, beginning about June 20. A typical herd of 20 large dairy cows and the young stock and other roughage-consuming livestock--total equivalent of about 30 cows--consumes about 120 tons of mow-dried hay, or 60 tons of hay and 120 tons of silage, during the winter and the periods of short pasture in the summer. Because hay and silage shrink about 20 percent in weight in storage, approximately 75 tons of hay and 150 tons of silage are handled at harvest time to get 60 tons of dry hay and 120 tons of settled silage.

Normally about 50 tons of first-crop hay is put up between June 20 to July 10, about 25 tons of second-crop hay between August 15 and 31, and the 150 tons of silage between September 5 to 20 in this area. This distribution of the harvesting of roughage helps reduce the peak load of labor during late June and early July. Even so, it is a strenuous time because corn cultivation and haying overlap and, with chores, work piles up. Moreover, in order to get the best quality of hay, it is desirable to put up the hay within a short period when the nutritive value is the highest.

A first cutting of 50 tons requires about 25 acres of a good stand of mixed alfalfa, clover, and grass hay--the mixture commonly used. Cutting 25 acres can be done in 3 days with 2 good horses and a 5-foot mower. Raking can be done with 2 horses in about half that time. With a 7-foot power mower the cutting can be done in 1 to 1-1/2 days. Raking takes nearly as long with a tractor as with horses, but with either horses or a tractor the cutting and raking are not difficult. The hard part of harvesting hay, on most farms, comes in getting the hay from the windrow into the mow or stack.

1/ This reports a part of a Nation-wide study of hay-harvesting practices made by the Bureau of Agricultural Economics in cooperation with several State Agricultural Experiment Stations. W. W. Wilcox of the Wis. Agr. Expt. Sta. and George A. Pond of the Minn. Agr. Expt. Sta. helped plan the study in these States. John W. Bowditch of the Wis. Agr. Expt. Sta. and Truman Nodland, George E. Toben, and S. A. Engene of the Minn. Agr. Expt. Sta. helped in the field work and gave valuable suggestions during the progress of the study.

State-Wide Survey of Practices in 1944

New machines have been used for putting up hay from the windrow to the mow or stack in recent years. In 1944 farmers in Wisconsin used pick-up balers to put up about 7 percent of their hay, buckrakes for 4 percent, choppers for 1.4 percent, hay loaders for 71 percent, and 15 percent was pitched by hand (table 1). In Minnesota, they used the pick-up balers for harvesting about 7 percent of their hay, some type of buckrake for 31 percent, choppers for less than 1 percent, hay loaders for 34 percent, and they pitched 26 percent by hand. In both States the hand pitching was done mainly in the northern parts. More hay was harvested with buckrakes than with any other machine in western and north-central Minnesota, where from 1/2 to 2/3 of the hay was stacked. These areas have less rainfall to damage the hay, and less lumber for building hay shelter than the areas farther east and south in Minnesota and in Wisconsin. Thirty-eight percent of the 1944 crop was stacked in Minnesota, compared with 8 percent in Wisconsin.

Table 1.- Percentage of hay harvested by specified methods
in Wisconsin and Minnesota, 1944 ^{1/}

Method	Wisconsin	Minnesota
	Percent	Percent
Loaded with hay loader	70.9	34.4
Horse buckrakes and other rakes	1.4	15.7
Auto or tractor buckrakes	3.0	15.2
Chopped before storing (not including grass silage)	1.4	.7
Baled with pick-up baler	7.0	7.0
Baled with stationary baler from windrow ...	1.0	1.2
Pitched by hand	15.3	25.8
	100.0	100.0

^{1/} Summary of mailed questionnaires sent to crop reporters by the Bureau of Agricultural Economics.

Study of Practices in 1945

Areas in Wisconsin and Minnesota, where farmers were using some of the newer methods of putting up hay, were selected for special study of their experience in 1945 with both the new and other methods. Near West Bend, Wis. a number of choppers and blowers were in operation. Around Watertown, Wis. a number of barn mowers were being used for distributing the hay as it is hoisted into the mow. Around Owatonna, Waseca, and Dodge Center, Minn. several buckstackers and some choppers and blowers and balers were in use. In all of these areas hay loaders were used on the majority of farms.

While the first crop of hay was being harvested in southeastern Minnesota, representatives of the State Agricultural Experiment Station and of the BAE were in the field observing and timing actual operations with the various kinds of equipment. In the latter part of August, 77 survey records were obtained from 77 farmers in southeastern Wisconsin, and during the early part of September similar records were obtained from 72 farmers in southeastern Minnesota. The aim was (1) to get at least 10 records in each State on each of the newer methods of putting up hay, and (2) to match each record of one of the newer methods with a record obtained from the nearest farmer who used a loader. In this way a random sample on hay loaders was obtained. As the experiences of farmers were about the same in the two States, the results are believed to be representative of other areas in these States where similar hay machinery is used.

Data were obtained of time and expense of labor, power, and equipment. Estimates of the quantity of hay put up were usually checked with estimates of yields and the measured volume of hay in mows or stacks. With balers, some of the bales were weighed so as to get "the feel" of bales of various weights. Usually four farmers were interviewed each day by each man in the field. This gave some time to observe the haying in progress and to size-up the hay crops, storage space, equipment, and haying crews.

Comparison of Methods in Use of Labor

Hours of labor used per ton on each farm for putting up hay from the windrow to the mow or stack are shown for southeastern Wisconsin and for southeastern Minnesota in figure 1. Some of the farmers used more than one method of putting up hay. The significant facts shown in figure 1 are that most of the farmers using loaders without special unloading equipment used between 2 and 3 hours of man labor per ton. Those using loaders on farms where barn mowers and hoists were available used between 1 and 2 man hours per ton. Farmers using buckrakes used from 1 to 2.5 hours, while those using buckstackers and choppers generally used between 1 and 2 man hours of labor per ton. Two who used one-man balers used only 1.5 hours of labor per ton. Most of those using other balers (mainly three-man balers) used between 2 and 3.5 hours of labor per ton.

If only the time of able-bodied men is included, the results are as shown in figure 2. This excludes the time of partly disabled men and of women and children. On this basis, the time per ton for loaders declines in most cases, to 1 to 2 hours per ton. For the loader combinations, buckrakes, buckstackers, and field choppers and blowers the time tends to center around 1 hour of able-bodied man labor per ton. Less drop is shown with the baler because the baler crews are made up mainly of able-bodied men. Loaders and buckrakes are used mostly on small and medium-sized farms where boys, girls, women, and partly disabled men help to some extent in putting up hay.

Strength, endurance, and skill are required for loading with the loader or baler, for distributing long loose hay or baled hay in the mow, and for stacking. Other help can be used for driving the team or tractor on the loader, hoisting hay into the mow with a power fork, and hauling bales or chopped hay.

Figure 1.- Hours of labor to put up 1 ton of hay from windrow to mow or stack with specified kinds of equipment, by farms, 1945

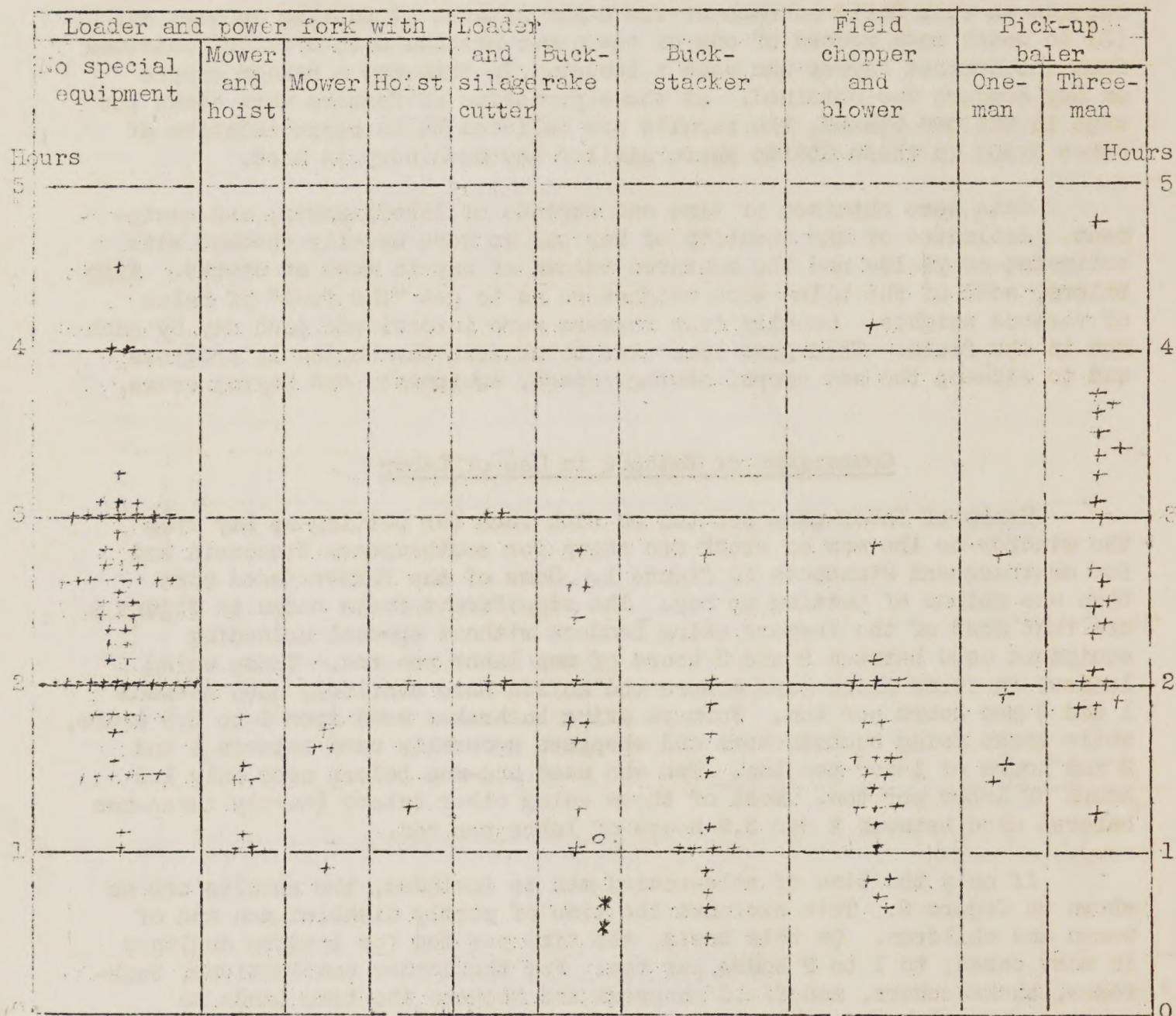
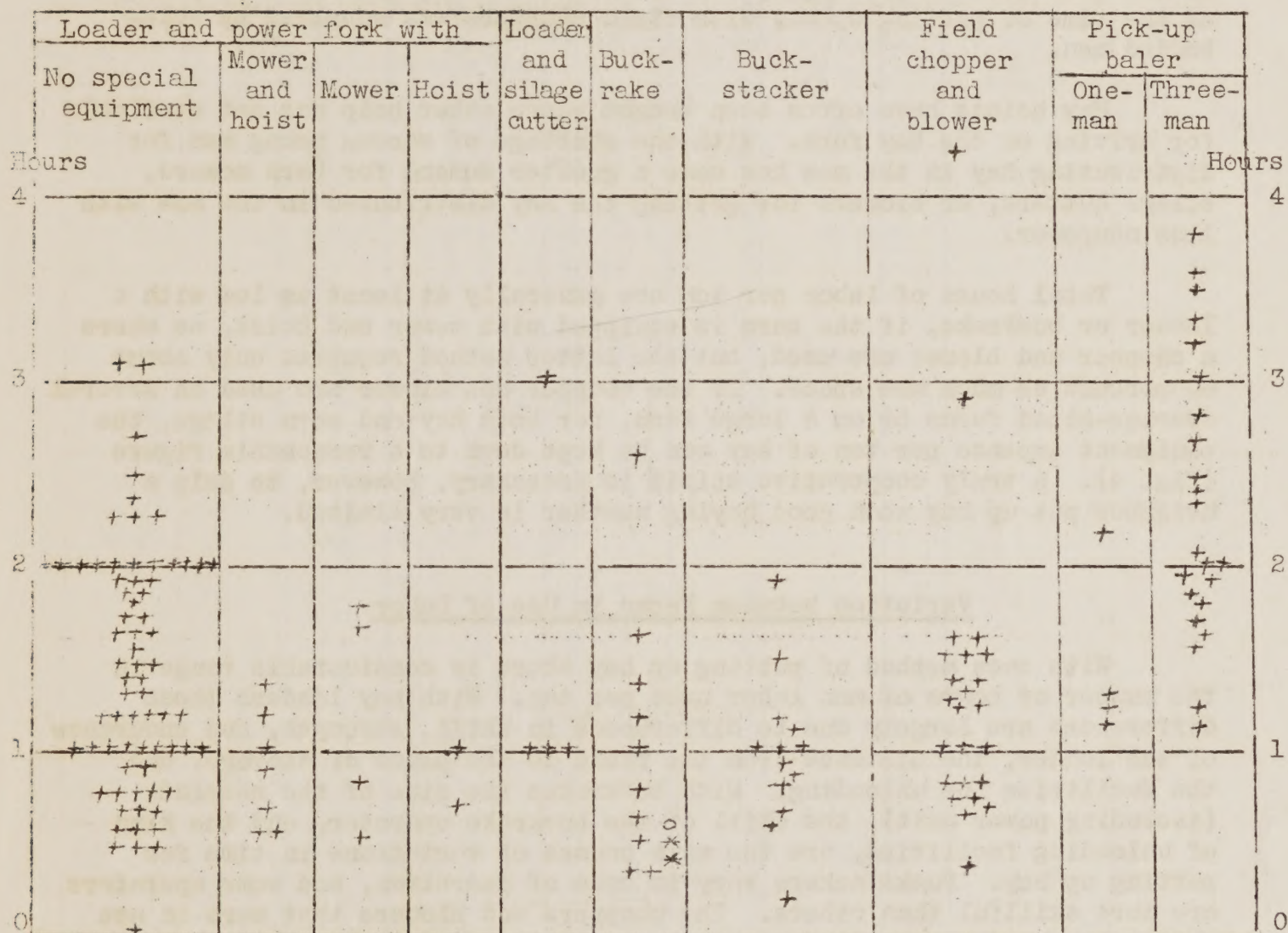


Figure 2.- Hours of able-bodied man labor (excluding all other labor)
to put 1 ton of hay from windrow to mow or stack with specified
kinds of equipment, by farms, 1945



* With mower or hoist.
o With mower and hoist.

The number of farms on which each method was used and the number of hours of able-bodied men and of other help used per ton in putting up hay by each method are shown in table 2. On most of the farms where the loader and buckrake were used, haying is largely a family job. Thus 58 out of 72 farmers who used the loader used other help as well as able-bodied men in putting up hay; 11 of the 13 who used the buckrake used other help beside able-bodied men in putting up hay. With buckstackers nearly all of the labor comprised able-bodied men--only 3 of the 13 farmers who used buckstackers used other than able-bodied men in the work. More than 90 percent of the time used in putting up hay with buckstackers and about 84 percent of the time of putting up hay with field choppers was supplied by able-bodied men.

Hay hoists have often been bought where other help was not available for driving on the hay fork. With the shortage of strong young men for distributing hay in the mow has come a greater demand for barn mowers, silage cutters, or blowers for getting the hay distributed in the mow with less manpower.

Total hours of labor per ton are generally at least as low with a loader or buckrake, if the barn is equipped with mower and hoist, as where a chopper and blower are used, but the latter method requires only about 60 percent as much mow space. If the chopper and blower are used on several average-sized farms or on a large farm, for both hay and corn silage, the equipment expense per ton of hay can be kept down to a reasonable figure (fig. 4). A truly cooperative spirit is necessary, however, to help a neighbor put up hay when good haying weather is very limited.

Variation between Farms in Use of Labor

With each method of putting up hay there is considerable range in the number of hours of man labor used per ton. With hay loaders these differences are largely due to differences in skill, strength, and endurance of the loader, the distance from the field to the place of storage, and the facilities for unloading. With buckrakes the size of the machine (including power unit), the skill of the buckrake operator, and the kind of unloading facilities, are the main causes of variations in time for putting up hay. Buckstackers vary in ease of operation, and some operators are more skillful than others. The choppers and blowers that were in use varied in capacity and the unloading facilities varied still more. Hay can be baled faster with a one-man baler than with a three-man baler and besides, the time of two men is saved. A trailer hitched to the baler saves a lot of time in loading. An elevator and a conveyor help considerably in storing the bales. A more detailed discussion of each method follows.

Hay Loader.-- The advantages given by most farmers who were using hay loaders were the low investment and expense, so farms of medium size can have one per farm. The farmer and others in the family usually put up hay in the afternoon when the moisture content reaches its lowest point.

Table 2.- Number of farms on which specified methods were used and average number of hours of labor used in putting up a ton of hay from windrow to mow or stack with specified kinds of equipment, 1945

Item	Loader and power fork with			Loader and silage cutter			Buck-rake			Buck-stacker			Field chopper and blower			Pick-up baler		
	Hours	Number	Hours	Hours	Number	Hours	Hours	Number	Hours	Hours	Number	Hours	Hours	Number	Hours	Hours	Number	Hours
Hours of labor																		
Able-bodied	1.45		.92	1.15	.85	1.50	.92	.99	1.31	1.50	2.36							
Other	1.02		.40	.50	.80	1.00	.79	.08	.26	.44	.38							
Total	2.47		1.32	1.45	1.65	2.50	1.71	1.07	1.57	1.94	2.74							
Number of farms																		
Using only able-bodied men	14	2		2	0	1	2	10	14	0	12							
Using other help	58	5		2	2	3	11	3	10	4	11							
Total	72	7		4	2	4	13	13	24	4	23							

The lighter work of cutting and raking is usually done in either the forenoon or the evening, or by someone who is not able to do the heavy work of loading or distributing hay in the mow. These strenuous jobs can be done at a faster rate, of course, if one does not stay at them more than 5 or 6 hours per day, consequently, some husky young men will load a ton of hay in 12 minutes, on the average. If a boy or girl is available to drive the team, tractor, or truck while the loading goes on, and again in hoisting the hay into the mow, the hay can be put up rapidly.

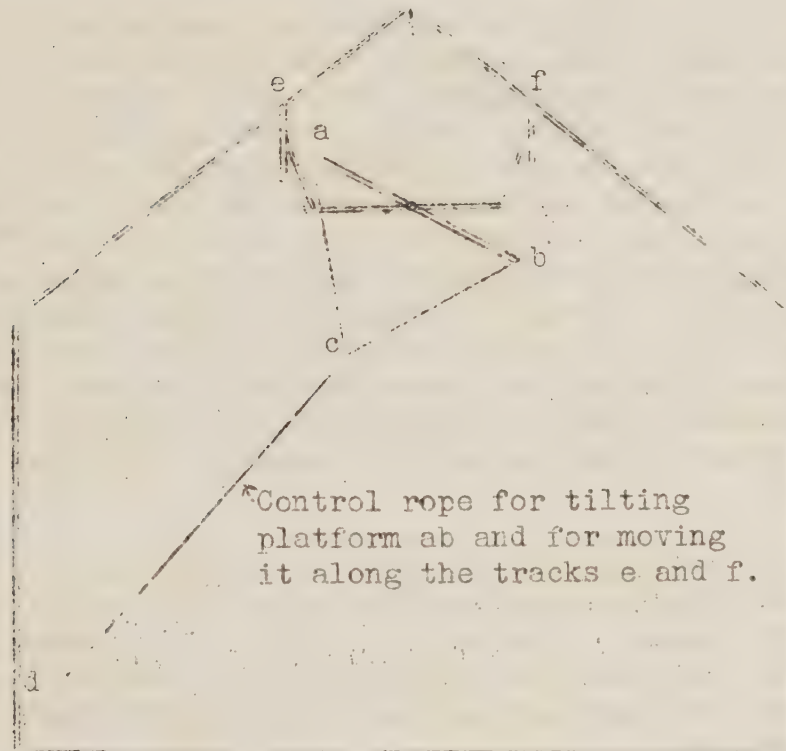
On one farm two young men changed off in loading. They had a strong team on the loader and another hitched to the hay fork. An older man stayed in the hay mow most of the time distributing the hay. The field was close to the barn. This crew put up 2 loads (1 ton per load) per hour, which is at the rate of 1.5 man hours per ton. But on some farms with 2 men on the load and someone driving, the loading took 25 minutes, the unloading 20 to 25 minutes, and the going to and from the field 10 to 15 minutes. This adds to 1 ton per hour for 3 men, or 3 man hours per ton. On most farms, with a hay loader and no special facilities for unloading, the time per ton varied from 2 to 3 hours (fig. 1).

On a few farms the differences in hours of labor per ton were due to the kind of help available. For example, if there are 2 men and a 12-year old boy on a farm, the boy is likely to go along with the men and drive when the hay is being loaded with the hay loader. The time he puts in driving back and forth and in loading may not save any time in putting up the hay. But the boy is sure to be on the job when he is really needed for driving to hoist the hay into the mow. If this crew of 3 puts up a ton of hay in 50 minutes, the total labor per ton is 150 minutes, or 2.5 hours. If instead of using the boy the farmer's wife or daughter helps only 20 minutes during unloading, the total time per ton would be 120 minutes, or 2 hours.

A few farmers skimmed on the work of distributing the hay in the mow and thus saved some labor at haying time. Using a barn mower for this work saves the heavy, hot job of mowing until the hay is nearly up to the plate, and then lightens the job until the mow is almost full. The diagram in figure 3 shows how the barn mower (or hay mower) operates. High, long barns with a driveway onto the mow floor are well adapted to the use of the barn mower. The average cost of those bought in 1945 was approximately \$170.

Under a fairly typical situation where there is an able-bodied man to load and handle the power fork, and a boy or girl to drive the team while loading and unloading, a ton load can be loaded and hauled in 30 minutes. Unloading with a barn mower can be done with the same crew in about 20 minutes if the unloading equipment is in good working order. Saving the one able-bodied man the heavy work of distributing in the mow enables him to keep up more speed in loading. Thus one man and one boy, under favorable conditions, can put up 1 ton of hay in 50 minutes. This adds up to 1.67 hours of labor per ton, or in terms of able-bodied man labor to 0.84 hours per ton. An exceptionally able man can sometimes cut this time down by 5 or 10 minutes per ton.

Figure 3.- End view of barn mower for distributing hay in hay mow



Scale 0.1 inch = 1 foot

The platform ab is 12 x 12 feet for barns 36 feet wide. It is tilted in the middle by means of a Y rope acbd which is fastened to some part of the barn frame. Chains from each corner of the platform to the frame keep the platform from tilting too far. Usually one load is unloaded with the mower in one position. Then the mower can be tilted the other way or pulled along the two parallel tracks at e and f by means of the same Y rope. The fork is tripped when it is directly above the platform and the hay slides down the platform and drops along the side. The middle is filled without using the mower.

If no suitable help is available for driving the team, tractor, truck, or auto on the hay fork, a hoist enables the man on the load to handle the fork or slings and the hoist alone. As an example of what can be accomplished with this equipment, 2 grown sons and the father with 2 trucks put up 11 tons of hay in 4-1/2 hours. The field was 240 rods from the barn. The sons alternated in loading and driving; the father unloaded with the hoist and barn mower. Thus, 11 tons of hay were put up with 13.5 man hours, or 1.23 man hours per ton.

Buckrake.- Under favorable conditions, such as short hauls, smooth fields and lanes, easy turns, suitable hoisting equipment, and a good power unit (automobile, truck, or tractor), hay can be put up with as few man hours per ton with a buckrake as with a field chopper and blower. If there is a driveway to the mow floor and plenty of height so that a barn mower and hoist can be used, the heavy work can be as nearly eliminated with a buckrake as with any other machine that has come to the writer's attention. Hay slings or large flexible grapple forks are generally preferred for hoisting the hay that is brought in with a buckrake. One farmer in the survey used a buckrake, barn mower, and hoist. The time for putting up hay on his farm averaged 1.1 man hours per ton. And even better performance with such equipment has been reported by the Cornell University Agricultural Experiment Station and the Nebraska Agricultural Experiment Station.

Many of the buckrakes used on the farms studied were home-made and some were mounted on old automobiles that had insufficient power for such work and that required frequent repairing. The following notes made in the field while observing the operation of six automobile-mounted buckrakes on six farms show some of the common causes for variations in hours of labor per ton.

- Farm 1.- No power lift, field too rough.
- Farm 2.- Not enough power, tire trouble, small rake, faulty attachment of rake to auto.
- Farm 3.- Rake too short, entrance to driveway too narrow.
- Farm 4.- Narrow gates, no power lift.
- Farm 5.- Rake too short, field too far from barn.
- Farm 6.- Rake too short, green hay, light tractor.

The present scarcity of old automobiles in good mechanical condition that are heavy enough to serve as power units for large buckrakes and of skilled labor for making the complete outfits, including power lifts, will limit the number of additional auto buckrakes that will be put into use in the next year or so. Some of the factory-built buckrakes have short teeth (6.5 to 7 feet), insufficient lift, and too much time is required to put them on and take them off the tractor. As the tractor must be used alternately for corn cultivation and haying, simple hitches save considerable labor and time. When these difficulties are overcome the buckrake can be used to advantage on many more farms than it was in 1945.

Buckstacker.- Stacking hay in the field with a good buckstacker can be done rapidly and with a small crew. The man hours per ton average slightly lower than the average of any other method in the survey (fig. 1). Twelve of the buckstackers were mounted on tractors and were therefore rather maneuverable. The other two buckstackers were mounted on wheels and attached in front of tractors. A skillful buckstacker operator will keep 2 other men busy stacking. The 3 men will put up hay, day after day, at the rate of 3 tons per hour, or 1 man hour per ton. On one farm a buckstacker was used part of the time as a buckrake to bring hay to the barn. Two farmers used it to load hay onto wagons; this method is slower than stacking in the field.

Ten of the farmers who used buckstackers also used one or two other implements for putting up hay. Six of them used loaders in addition to the buckstackers, two used buckrakes for a part of their hay, and two others hired pick-up balers for a part of their work.

The tonnage of hay harvested averaged nearly 100 tons where buckstackers were used in 1945. Operators of two of the smaller farms did some custom work with their machines. One man with a buckstacker and tractor put up hay at \$4 per hour and loaded manure for \$3 per hour; another charged \$3.50 per hour for putting up hay. One farmer who did not own one, hired a buckstacker with operator and tractor at \$3 per hour.

The records on buckstackers were all obtained in Minnesota, where stacking of hay is more common than in Wisconsin. No buckstacker was found in Wisconsin in the areas surveyed. The price, in 1945, of the buckstacker most commonly used was over \$400. So large an investment is not justified unless there is considerable stacking to be done. Men who are skillful in stacking hay are also essential to the success of this method.

As with other methods of putting up hay, everyone in the crew needs to be able to keep up his part of the work in order to get the whole job done efficiently. For instance, one father and son did not work together to the best advantage because the father could not stack as fast as the son could buck up the hay; on the other hand, when the son did the stacking the father could not bring up the hay fast enough to keep the son busy.

Some farmers put feeding racks on wheels and use them for bringing hay from the stack right into the barnyard. In this way the labor of feeding the stacked hay is not much different from the labor of feeding the hay out of the mow.

Field Chopper and Blower.- On the whole, farmers who used the equipment of field chopper and blower felt that they saved considerable time, a lot of sweat, and nearly half of the barn-mow space. The hours of man labor per ton were generally between 1 and 2 as shown in figure 1. This is about the same number of hours of man labor per ton as was used with the loader where a hay mower and hoist, or either one of these alone, was used in unloading. It took more time to put up 1 ton of hay with the chopper and blower than it took to stack it with a buckstacker, but less time than it took with the loader without special unloading equipment, or with the baler.

The investment in machinery and power is much higher with field choppers than with buckrakes, buckstackers, or loaders. A hay chopper and blower cost from \$750 to \$2,000 in 1945. In addition, two tractors and two trucks, or three or four tractors were used. Racks and wagons varied from home-made outfits costing \$50 each to large, closed trailers, with power take-off for unloading, costing \$400 each. Most of the field choppers had corn-cutting attachments and were used on fairly large acreages. Some were owned by two or more neighbors who exchanged labor and equipment. One farmer among those visited in each State did custom work. The lowest acreage covered per machine (including hay, straw, and corn silage) was 34 acres, and the highest was 290 acres. On the average, the acreage covered with a field chopper was about four times that covered with a hay loader.

One farm was equipped with a concrete platform and pit onto which a load of chopped hay or corn silage was dumped. The truck was then taken right back to the field for another load. One man tending the blower kept the hay or silage moving into the worm which fed the blower. The blower pipes were directed into the hay mow for hay or into the silos for corn silage.

When the field was near the barn, the field chopper was kept going about three-fourths of the time with one dump truck. It could be kept running steadily with two dump trucks if the distance between field and barn was not unusual. Any unloading device which feeds directly into the blower keeps the driver and truck or trailer at the blower until the load is run through the blower unless an extra truck or trailer is available for the driver to take back to the field. If the unloader is power driven, one man can tend to unloading and feeding the blower. If the unloading has to be done by hand (the more usual way) it takes two men at the blower.

During 1945 there was some unusual trouble with breakages, delays in getting repair parts, and plugging of machines due to heavy, damp windrows of hay. Small stones on the surface also caused some delays. By 1946 manufacturers will have improved their machines, repair parts will become more plentiful, and farmers will have more experience in operating the machines. Thus more farmers who use field choppers will get their hay up (windrow to mow) in 1 hour of man labor per ton.

A goal of 1 ton of hay put up with 1 hour of labor would mean 4 tons per hour for a crew of 4 men. With hay yielding 2 tons per acre the first cutting, this would mean putting up 2 acres per hour. With a 7-foot mower, which actually cuts a swath about 0.4 rod in width, it takes a swath or windrow 800 rods long to make 2 acres. In a field 80 rods long this means 10 windrows the length of the field. One windrow up and one back would yield 1,600 pounds (0.8 ton) which would approximately fill a box 8 x 14 feet and 5 to 6 feet high.

Pick-up Baler.-- Most of the pick-up balers on which records were obtained did not save labor (fig. 1) or expense (fig. 4) in putting up hay, but on some farms they either saved needed storage space or prepared the hay for sale. Where fields were far from the barn, or where the hay had to

be moved for feeding, baled hay also had some advantages over loose hay. A considerable part of the baling was done by custom outfits that were hired when no other hired help was available.

Records were obtained on only four one-man, self-tying balers--two in each State. One-man balers usually save two men of the baling crew and they also bale faster than the three-man, hand-tying balers. Seven of the 10 farmers interviewed in Wisconsin and Minnesota, who had three-man balers, said they planned to get one-man pick-up balers when they become available. Thus, in a few years many of the three-man, hand-tying balers will be replaced by the faster one-man, self-tying balers.

When a trailer is hitched to a one-man baler so that one man can load the bales as they come from the baler, considerable time can be saved. If only a part of the hay is baled and it can be stored in barn driveways or sheds without having to pile the bales up high, the unloading can be done quickly by hand. However, if the bales have to be moved some distance and to some height, then adequate power-driven elevating and conveying equipment is needed in order to save man labor on the large jobs comparable to the savings made with other methods of putting up hay.

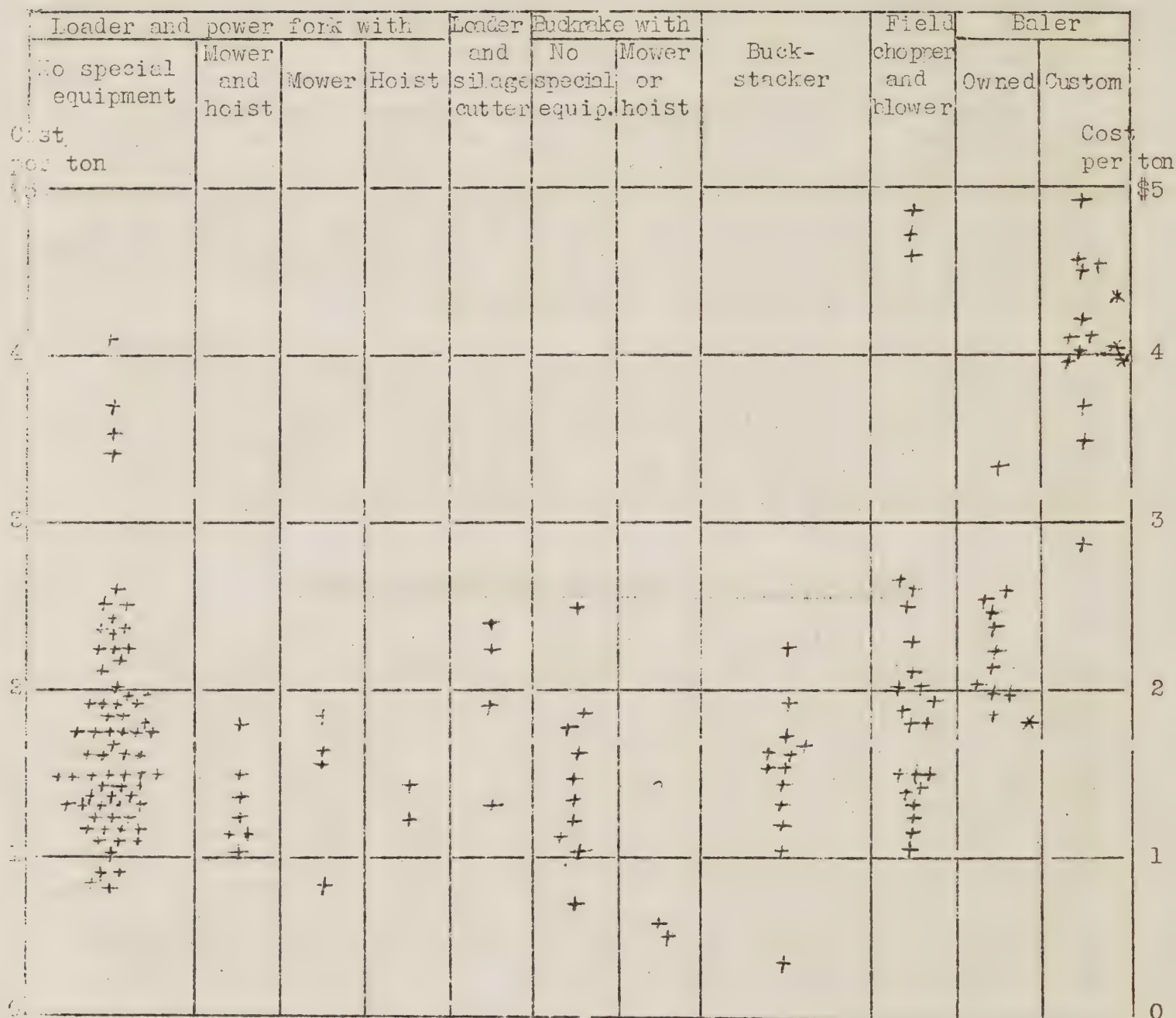
Only a few farms were well equipped with elevators and conveyors for unloading and placing the bales in hay mow or shed. But this lack of equipment was often offset by unusually rapid but hard work by those who hauled and unloaded the bales. A few neighbors working together often kept up with a custom baler on jobs of 1/2 to 1 day in length. But they could not have kept up that pace on jobs lasting several days.

Comparison Between Methods and Farms in Costs

Costs for putting up hay from the windrow to the place of storage were calculated for the 149 farms studied. In addition to hours of work, most of the farmers gave estimates of the actual costs and probable years of life of the principal machines used--hay loaders, special unloading equipment, buckrakes, buckstackers, choppers and blowers, and pick-up balers. The time for able-bodied man labor, tractors, and trucks was charged at \$0.50 per hour, other labor at \$0.25 per hour, and horse work at \$0.20 per hour. The cost of wire or twine for baling averaged approximately \$0.50 per ton on the farms for which accurate information could be obtained, and that cost was applied to some of the other farms that used their own balers. Costs were not calculated for cutting and raking since these operations are fairly well standardized, and are much the same no matter what method is used in getting the hay from the windrow to the barn, shed, or stack.

The calculated costs for each of the farms are shown in figure 4. The substitution of machinery and power for labor is apparent in comparing costs with the hours of man labor (fig. 1). Thus the loader without special equipment for unloading is high in labor per ton compared with the barn mower and hoist, buckrake, buckstacker, and field chopper, but a comparison on a cost basis shows a central tendency (average) around \$1.50 per ton--slightly lower for buckrakes, but higher for field choppers (table 3). Costs of putting up hay with balers (especially the custom balers) are noticeably higher both in cost per ton and in man hours per ton.

Figure 4.- Cost for labor, power, and equipment to put up hay from windrow to mow or stack, by farms, 1945.



o Buckrake with barn-mower and hoist.
 *. One-man baler.

Table 3.- Average cost per ton for putting up hay from windrow to mow or stack, by methods, 1945

Item of cost	Loader and power fork with				Loader and silage cutter	Buckrake	Duck-stacker	Field chopper and blower	Baler	
	No special equipment	Mower and hoist	Mower	Hoist					Owned	Custom
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Labor										
Able-bodied	.73	.46	.58	.42	.75	.46	.50	.66	.97	.71
Other	.26	.10	.07	.20	.19	.20	.02	.07	.15	.04
Total	.99	.56	.65	.62	.94	.66	.52	.73	1.12	.75
Horse work	.21	.13	.27	.20	.10	.01	---	.02	---	.04
Tractor	.26	.11	.04	.17	.37	.25	.28	.54	.31	.18
Truck	.05	.06	.10	---	.12	.09	---	.10	.03	---
Haying machines	.20	.39	.32	.33	.47	.30	.65	.79	.36	1/3.10
Wire or twine	---	---	---	---	---	---	---	---	.50	---
Total	1.71	1.25	1.38	1.32	2.00	1.31	1.45	2.18	2.32	4.07

1/ Labor of baling crew and wire or twine are included under this item.

Labor comprised nearly 60 percent of the cost of putting up hay with hay loaders and no special equipment. With the field chopper and blower, labor comprised about 33 percent. However, the equipment cost of the field chopper and blower amounted to \$0.79 per ton, or 36 percent of the total, whereas the equipment cost of the hay loader was \$0.20 per ton, or about 12 percent of the total. Hay was put up with buckstackers at low costs per ton for labor but moderately high costs for the equipment.

Costs were unusually high for chopped hay on a few farms largely because high-cost machinery was used on small acreages (fig. 4). The differences in amount of work done with any of the machines used is an influential cause for variations among farms in the costs per ton. Even a hay loader is fairly costly per ton if only 20 tons of hay are put up with it. Equipment costs for all machines tend to be lower on the farms on which large quantities of hay or other roughage were put up.

The practical problem on many farms in the past few years has been to get hay put up. Whichever was more available--labor or machinery--was taken in order to get the work done. Costs were not always the first consideration.

Advantages and Disadvantages of Various Haying Machines--
Summary of Answers given by Interviewed Farmers

The heavy work in putting up hay was mentioned by 50 out of 142 farmers in both States who gave an answer to the question as to the advantages or disadvantages of their present methods (table 4). Twenty-one of the 24 farmers using choppers claimed less heavy work as an advantage of this method. Seven of the 13 farmers using barn mowers or hoists also gave less heavy work as an advantage of their method. Three of the 11 farmers using buckrakes and 4 of the 9 farmers using buckstackers gave the same advantage for their methods.

Heavy work was mentioned as a disadvantage by 6 out of 72 farmers using loaders with no barn mower or hoist for unloading; by 2 out of 4 using the loader and silage cutter, and by 5 out of 9 using pick-up balers.

The low investment and low expense were mentioned as advantages by about one-third of the farmers using loaders, with or without barn mowers or hoists. Saving in time was mentioned as an advantage by about one-half of the farmers who were using buckrakes, buckstackers, choppers, and balers. Apparently in the case of the balers some of the farmers were thinking of the elapsed time rather than the man hours per ton. Usually, baling crews are two or three times as large as those used with the loader, buckrake, or other crews, and thus get a job done more quickly than it could be done with the smaller crew and other equipment. However, the man hours per ton are generally higher with the baler.

Table 4.- Number of farmers who gave specified advantages and disadvantages of their present methods for putting up hay

Machine	: Number : Advantages : Disadvantages						
	: inter- : Low : : Less : : :						
	: viewed : invest- : Low : Time : heavy : Too : Heavy						
	: Wis. and: mont : expense: saving : work : slow : work						
	: Minn. : : : : : : :						
	Number	Number	Number	Number	Number	Number	Number
Loader	72	32	24	5	2	5	6
Loader with mower, hoist, or both	13	5	5	2	7	1	0
Loader with silage cutter	4	0	0	0	0	1	2
Buckrake	11	1	1	5	3	0	0
Buckstacker	9	0	0	5	4	0	0
Chopper and blower ..	24	0	3	12	21	0	0
Baler	9	0	0	5	0	0	5
Total number	142	38	33	34	37	7	13

New Machinery that Farmers Plan to Buy When Available

More farmers in this survey (14 out of 138 who gave an answer to the question) are planning to buy one-man balers than any other machine for putting up hay. One-half of these are farmers who have used three-man balers. Five of the 72 farmers with loaders also plan to buy one-man balers.

Second on the list of new machines to be bought is the chopper and blower. One of the 24 farmers who are using these machines plans to get a larger and stronger machine as soon as possible. Two of the four farmers who used loaders and silage cutters in 1945 plan to get field choppers and blowers when they are available. Four out of 72 farmers who used loaders also plan to get choppers. Three choppers are to be bought (one each) by farmers now using buckrake, buckstacker, and baler.

Conclusions on Selection of Haying Equipment

On the average, the saving in labor or expense in putting up hay is not so large for any one kind of equipment as to lead to a rapid change in favor of it. Nevertheless, as more kinds of equipment become available there are opportunities on many farms for getting machines that are better adapted to specific conditions on those farms. The conditions to which the different methods appear to be best adapted may be summarized as follows.

Hay loader.-- The hay loader is adapted to the small or medium-sized farm which has more hay than the farm crew wants to pitch by hand. It saves a lot of heavy work compared with hand pitching, but still leaves loading and mowing (distributing hay in the mow) to be done by hand. Both of these are heavy jobs. The speed of putting up hay is largely set by the loader and to a less extent by the man in the mow since that job is sometimes slighted. Rough ground and distant fields are not so serious handicaps for a hay loader as for a buckrake.

Buckrake.-- The buckrake is adapted to the small or medium-sized farm that has hay fields near the barn or storage place, that has smooth fields and lanes, and easy turns. The buckrake operator does not need to have the strength of a fast loader, but he must be skillful. A large buckrake, a large power unit (auto, truck, or tractor), and good equipment for hoisting hay into the mow or onto the stack, are essential for fast work. A sling or a large 4-tine flexible grapple fork has been found to be the most satisfactory equipment for hoisting the hay brought in with a buckrake.

The barn mower and hoist work the same way with the buckrake as with the hay loader. If suitable labor is not available for distributing the hay, or for driving on the power hay fork, these jobs can be taken care of with the barn mower and hoist. The barn mower can be used to best advantage in a high, long barn with a driveway onto the mow floor. Under these conditions, and with good equipment, the hay can be put up as fast and as easily with a buckrake as with any machine found in this study.

Buckstacker.-- Buckstackers are adapted to farms above average in size that are short of barn-mow space. Fields should be smooth for rapid stacking. With good equipment, a good operator, and smooth fields, two able stackers are needed. It is one of the best time-saving machines for stacking hay in the field. The stacking is heavier work than distributing hay with a barn mower.

Field chopper and blower.-- This machine is adapted to large farms or to two or more medium-sized farms, and is especially useful where hay-mow space is limited. With the corn-cutting attachment farmers like it for putting up corn silage; this additional use lowers the overhead machinery cost per ton of hay. As used in 1945, the man hours per ton were about as low for the chopper as for the buckrake alone, or for the hay loader supplemented with barn mower or hoist, or both. The work with chopper and blower is not so heavy as with the hay loader, but expenses for machinery and power are higher. Power equipment, in the form of a power take-off for unloading trailers or a dump truck, is coming into use on a few farms; it lightens the work still more and saves man labor, but it raises the equipment cost.

Pick-up baler.-- A pick-up baler is adapted to a large farm, to custom work, limited storage space, long hauls, or for preparing hay for sale. One-man balers with trailers hitched on, and power unloading equipment can bring down the man hours per ton nearly to the time used with the other new haying machinery.

